

NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(acre)
CODE 590

DEFINITION

Managing the amount, form, placement, and timing of application of plant nutrients.

these guidelines. Possible differences include nutrient extraction methods, soil sampling depths and frequency, and recommended nutrient application rates and volumes specified in this standard.

PURPOSES

This practice is to be applied as part of a conservation management system to support one or more of the following:

- To supply plant nutrients for the optimum forage and crop yields.
- Provide nutrients to quickly obtain and maintain adequate vegetation for conservation cover, critical areas, grassed waterways, vegetative buffers, or wildlife habitat.
- Minimize entry of nutrients to surface and ground water.
- To maintain or improve chemical and biological conditions of the soil.

Nutrients will be applied to meet crop requirements based on the intended purpose. When nutrient management plans are designed to meet a specific nutrient application (e.g. P), other nutrients (e.g. N) will be applied as required to meet crop needs.

Erosion control, runoff control, and water quality practices shall be installed to reduce soil loss and runoff that may carry dissolved or attached nutrients into ground or surface water. Erosion control will be determined by the use of the appropriate current erosion prediction technology.

Nutrient management plans initially will be developed using a current soil test (not over 1-year-old) which will serve as the baseline soil nutrient availability. Subsequently, the frequency of soil tests will be based on the primary purpose given in Appendix 1.

CONDITIONS WHERE PRACTICE APPLIES

On land where plant nutrients are applied.

Follow current soil sample collection guidance provided by the Soil, Water, and Forage Testing Laboratory, Soil and Crop Sciences, Texas A&M University, Texas Agricultural Extension Service (TAEX) and provide complete information pertaining to yield goals, previous application of lime, manures and/or fertilizers, crop history, soil series and texture. Sampling depths will depend on cropping system, tillage system, and fertilizer application method. Appendix 2 contains the soil sampling depths based on tillage practices. Soil testing shall include analyses for any nutrients for which specific information is needed to develop the nutrient plan. Request analyses pertinent to monitoring or amending the annual nutrient budget,

GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

A nutrient management plan will be developed to specify the kind, source, amount, timing, and application method of nutrients to meet crop needs. Nutrient applications will be made in accordance with this standard and other applicable state or local regulations. **NOTE:** State regulations for application of animal wastes take precedence over

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

**FOTG, SECTION 4
All Field Offices, TX
June, 2000**

e.g. pH, electrical conductivity (EC) or salinity, nitrate-nitrogen, and extractable phosphorus and potassium. For additional guidance, refer to TAEX Bulletin, L-5175, Managing Crop Nutrients through Soil, Manure, and Effluent Testing, dated 11/98.

Total nitrogen applied in any given year shall not exceed the crop requirement for the realistic yield goal based on a soil test recommendation or a nutrient budget. The realistic yield goal is defined as the estimated yield within 125% of highest yield of the last 10 years or in lieu of yield history, consult a Nutrient Management Specialist.

Nitrogen shall be applied as close to planting as possible. Pre-plant nitrogen application should not precede the normal planting date of the target crop in the FOTG by more than 120 days if incorporated within 48 hours and 30 days if surface applied.

Inorganic nitrogen and phosphorus applications shall not exceed soil test recommendations by more than 10% (allowance for fertilizer application variations and calculation errors). Pre-plant starter fertilizer may be knifed in or injected when no nutrient(s) has (have) been recommended based on the soil test recommendations. Nutrient planning shall be based on current soil test results developed in accordance with TAEX soil fertility guidance or industry practice if recognized by TAEX. Soil analyses shall be performed by laboratories that are accepted in one or more of the following: North American Proficiency Testing Program under the Soil Science Society of America umbrella or laboratories whose tests are accepted by TAEX as listed in Appendix 3. The soil test results and recommendation are to be reviewed with the producer by TAEX, NRCS, or other Nutrient Management Specialist certified by Texas NRCS.

For all purposes, except maintaining vegetative cover, a nutrient budget (using data from Appendix 4) may be used to set application rates during years between soil tests. When the nutrient budget worksheet is used, a recent soil test with cropping and fertility history is required to provide the baseline condition. Refer to the Nutrient Management Conservation Practice Job Sheet referenced in Appendix 5.

Annual phosphorus application rates will follow guidance in Appendix 6. The Phosphorus Index (PI), Agronomy Technical Note Number TX - 15, will be used when animal wastes are applied.

Phosphorus from animal wastes may be applied every other year at the biennial rate listed in Appendix 6. When this biennial rate has been used, no additional phosphorus fertilizer or animal wastes may be applied in the alternate year. However, supplemental nitrogen and/or potassium to meet the yield goal may be needed in the alternate year.

The multiple year rates of animal waste may be applied only if erosion and runoff control practices are installed to minimize risk of nutrient movement.

Animal wastes applied to land will be analyzed for total N, P, and K content. Applications will be made based on a current (within the last 12 months) manure sample or an analysis history for at least two years. For further information and guidance, refer to the NRCS Agricultural Waste Management Field Handbook and/or Waste Utilization Standard, 633, in the FOTG. **EXCEPTION:** In lieu of current manure analysis or history, published NRCS values for N, P, and K from the Waste Utilization Standard (633), may be used for the initial plan.

If the application of manure, wastewater, or other organic material does not supply the proper balance or amount of nutrients to achieve the desired yield goal in the application area additional inorganic nutrients shall be applied.

ADDITIONAL CRITERIA TO SUPPLY PLANT NUTRIENTS FOR OPTIMUM FORAGE AND CROP YIELDS.

Nutrients will be recommended for all crops, pasture, and hayland based on realistic yield goals, normal soil moisture and climatic conditions, individual management capabilities, planned cropping system, and soil productivity of the site.

Appendix 4 of this standard and/or current specific crop production guidelines will be used for nutrient planning and balance purposes after the soil test baseline has been established. Application rates, timing, and methods may be adjusted during the growing season in response to changing environmental conditions or production factors. Refer to TAEX Nutrient Management Fact Sheets, specific crop production guidelines, such as Rice Production Guidelines, for current guidance.

**FOTG, SECTION 4
All Field Offices, TX
June, 2000**

ADDITIONAL CRITERIA TO MINIMIZE ENTRY OF NUTRIENTS INTO SURFACE AND GROUND WATER.

The effects of nutrient application on water quality will be assessed. Additional water quality criteria will be used when the acreage is in a watershed where a TMDL for nutrients has been designated by Texas Commission on Environmental Quality. In areas where surface water quality concerns need to be addressed, phosphorus application rates will follow the guidance in Appendix 6. Nutrient screening tools, such as PI, Nitrogen Leaching Index, etc. will be used, when appropriate, to assess movement potential of applied nutrients.

When the PI is used, nutrient management plans shall include:

- A record of the site vulnerability ratings for each field impaired by nutrients.
- Information about conservation practices and management actions that can reduce the potential for phosphorus movement from the field.
- Adjustment for P application will be based on the above information.

Limit nutrient application to the amount needed to produce a realistic yield. Use split applications of inorganic N and other techniques to minimize any potential nutrient loss. Use nutrient timing, form, and method of application which are least susceptible to nutrient movement.

When ground water quality concerns for nitrate-nitrogen are present, nitrogen will be applied in split applications at a rate not to exceed 100 pounds of actual nitrogen or 50% of the annual soil test recommendation or nutrient budget per application, **WHICHEVER IS GREATER.**

On coarse textured soils in recharge areas defined by TNRCC as sensitive aquifers, areas defined by NRCS as subject to frequent flooding, and areas

with high water tables, not perched, apply the **LESSER** of: 100 pounds of actual nitrogen or 50% of the annual soil test recommendation or nutrient budget recommendation per application.

Additional management practices, e.g. Residue Management-Mulch Till (329b), Residue Management-Ridge Till (329c), Filter Strip (393), Contour Buffer Strips (332), Grassed Waterway (412), Field Border (386), Vegetative Barriers (601), Cross Wind Trap Strips (589B), Herbaceous Wind Barriers (422A), Windbreaks / Shelterbelts (380), Sediment Basin (350) or other appropriate conservation practices in the FOTG will be installed to address the appropriate surface water quality concerns.

Use chemigation and foliar application techniques to provide nutrients where appropriate. Maintain properly calibrated equipment in good working order. For more information on chemigation, refer to TAEX bulletins Chemigation Equipment and Safety, L-2422; and Chemigation Workbook, B-1652.

ADDITIONAL CRITERIA TO QUICKLY OBTAIN AND MAINTAIN ADEQUATE VEGETATIVE COVER FOR CONSERVATION COVER, CRITICAL AREAS, GRASSED WATERWAYS, VEGETATIVE BUFFERS, OR WILDLIFE HABITAT.

FOR ESTABLISHMENT:

- Follow current soil test recommendations.
EXCEPTION: These rates may be modified by a Nutrient Management Specialist certified by Texas NRCS when native species are being established alone or in combination with aggressive, introduced species.

For soils with a historically low pH, take a soil test and follow its recommendations or use a field pH test and apply lime in accordance with a soil test lime requirement method.

At or near planting, incorporate all nutrient applications to a depth of 3-6 inches, except in areas where a dead litter crop is present, then do not incorporate. Nitrogen applications will not exceed

40 lbs./ac at the time of seedbed preparation and seeding. Additional nitrogen will be applied according to the current soil test recommendations after the plant root and top growth have been established.

FOR MAINTENANCE:

Apply additional nutrients as needed in subsequent seasons until the vegetative cover is adequate to accomplish its intended purpose.

Use a current soil test or nutrient balance worksheet to determine the fertility needs to reach the desired production goal. Use a soil test when vegetative criteria of the practice (stand density, plant height, growing condition, or species diversity) has not been achieved.

ADDITIONAL CRITERIA TO MAINTAIN OR IMPROVE CHEMICAL AND BIOLOGICAL CONDITIONS OF THE SOIL.

When yields exceed goals by more than 10% or termination of a non-legume crop, cover crop, or green manure crop, additional nitrogen will be applied to supplement for the nitrogen used by soil microbes for the breakdown of the non-legume crop residue, cover, or green manure crop.

Estimated nitrogen amounts needed per ton of crop residue are:

- Add 10 lbs. N per ton of dry residue from non-legume crops.
- Add 5 lbs. N per ton non-legume cover or green manure crop produced.

Soil pH, as an indicator of potential aluminum toxicity to plants, is of critical importance in proper nutrient management maximizing the benefits of fertilizer application. Lime will be applied to soils when the soil reaction falls below the optimum pH range of the managed crop. Refer to a current soil test for liming recommendations.

CONSIDERATIONS

The following considerations are management guidelines that, when used alone or in combination with structural or cultural practices and controls, will assure the desired crop requirements and

prevent or reduce the risk of non-point source water quality impacts of agricultural production. These guidelines may be modified to adapt to changing environmental conditions and crop management systems.

1. A nutrient budget may be calculated and used to aid in making adjustments. Appendix 4 will be used to estimate crop nutrient needs based on yield goal. The Nutrient Management Conservation Practice Job Sheet (Appendix 5) may be used to document nutrient budget calculations.
2. Additional soil tests should be considered after years of extremely high or low production. This is $\pm 30\%$ of the realistic yield goal.
3. Plant tissue analysis may be used as part of a complete nutrient management system. Follow sampling and mailing instructions provided by the selected testing laboratory.
4. Management practices such as winter cover crops and deep-rooted crops can be used to take up residual nutrients applied previously to rotational crops preventing the movement of these nutrients out of the root zone.
5. When feasible, apply phosphorus fertilizers (P_2O_5) in bands 3-6 inches deep and 2-3 inches to the side of the crop row. If phosphorus is broadcast on cropland, incorporate to 2-6 inches or have surface soil conditions that reduce runoff and erosion.
6. When nitrogen is applied, split applications will be considered. When ground water quality is a concern, split application of nitrogen is recommended.
7. When using liquid fertilizers in standing crops, exercise care to avoid foliar damage.
8. When the soil analysis shows the pH is adequate, but the soil is low in available calcium, an amendment with calcium such as calcium sulfate (gypsum) may be used to provide the needed calcium without affecting soil pH.
9. Alternatives to reduce the use of commercial fertilizers to meet crop demands include:
 - A. Properly inoculated legumes can reduce the need for commercially applied nitrogen by providing nitrogen to the following crop.

Further guidance on the use of legumes as fertilizers can be found in the Standard for Cover and Green Manure Crops (340).

- B. Properly applied animal wastes may be substituted for commercial fertilizer. Further guidance on the utilization of animal wastes for nutrients can be found in the NRCS Agricultural Waste Management Field Handbook and the NRCS Waste Utilization Standard (633).
10. On sites where soil salinity is a concern, the Potassium application rate should not exceed 100% of the requirement needed over the entire crop rotation, or three years for perennial crops.

PLANS AND SPECIFICATIONS

Specifications for the application of Nutrient Management shall be prepared for each field according to the Criteria, Considerations, and Operations and Maintenance described in this standard.

The individual field specifications shall be documented on specification sheets, job sheets, narrative statements in conservation plans, or other appropriate documentation.

Plans and specifications shall include these items:

- Purpose of Nutrient Management Plan
- Yield goal
- Crop rotation
- Sampling and shipping procedures for soil, manure, effluent, and plant tissue
- Soil test results and/or nutrient budget
- Nutrient application
 - * rate
 - * form/sources
 - * timing
 - * method of application
- Factors that may have environmental impacts (slope, soils, karst topography, tile drainage, irrigation, etc.)
- Appropriate considerations
- Operation and Maintenance requirements
 - * frequency of soil tests
 - * calibration of equipment
 - * disposal of excess materials

OPERATION AND MAINTENANCE

Nutrient applications will be made according to a soil test, which serves as the baseline soil condition.

The producer should review the nutrient management plans on an annual basis. Nutrient management plans should also be reviewed with a Nutrient Management Specialist immediately after soil test samples and recommendations have been completed as specified in Appendix 1.

Nutrient management plans should be revised when:

- crop rotation changes
- changes occur in farming operations or management systems
- changes occur in technology and/or available data
- new soil test analyses with revised recommendations are received.

Application equipment should be regularly calibrated to deliver within 10 percent of the intended application rate to achieve a uniform distribution pattern.

Do not use anhydrous ammonia unless loose soil is available, and soil moisture conditions are adequate to insure proper closure of the furrow. Appropriate mechanical devices (packer wheels, harrows, etc.) may be used as needed to close the applicator furrow.

Avoid unnecessary contact with fertilizers and organic wastes. Where the label specifies a precaution, wear proper clothing, footwear, respirator, and gloves as stated on the label. Extra caution should be maintained to prevent skin and eye contact or exposure to ammonia fumes.

When cleaning equipment after nutrient application, remove and save fertilizers or waste in an appropriate manner. The saved residue material may be utilized on another crop as part of the fertilization program. If the equipment is flushed, keep wastewater away from high runoff areas, ponds, lakes, streams, wells and other water bodies.

Dispose of fertilizer containers according to any applicable label directions and state, federal, and local laws.

APPENDIX 1

SOIL TEST FREQUENCIES (in years) ^{1, 2, 3}

Purposes	Rainfall < 25"	Irrigation + Rainfall > 25"	Animal Wastes
Optimum Yield	1 of 5	1 of 3	Each Year prior to Application
Vegetative Establishment ⁴	Prior to planting	Prior to planting	Prior to planting
Water Quality	1 of 5	1 of 3	Each Year prior to Application
Soil Condition	1 of 5	1 of 3	Each Year prior to Application

¹ **NOTE:** State regulations for application of animal wastes take precedence over these guidelines. Possible differences include nutrient extraction methods, soil sampling depths and frequency, and recommended nutrient application rates and volumes specified in this standard.

² For nutrient budgets between soil tests, use the following guidance:

Nitrogen – up to the crop requirement

Phosphorus and Potassium – up to the crop requirement unless the soil test level in year one is very high (VH). For Very High or Higher P or K levels, additional nutrients are not recommended in the second or third year unless banded in small amounts or used as pop-up fertility. Amounts up to the crop requirement may be used in the fourth and fifth year after the baseline soil test, if applicable. Recommended application rates will be comparable to Texas A & M soil lab recommendations for the planned yield goal.

³ Annual soil testing is strongly encouraged especially in situations with high yield potential.

⁴ After establishment year, hay and pastures will follow the appropriate purpose regarding frequency. Additional (after establishment year) soil testing for other vegetative practices will only be done if nutrient deficiency symptoms are evident.

APPENDIX 2

SOIL SAMPLING DEPTHS ^{1, 2}

Cropping System	Tillage System	Fertilizer Application Method	Recommended Sampling Depth (inches)
Row crops where stratification issues are anticipated	All	Injection (> 6 inches)	3 – 9
No-till systems where stratification issues are anticipated	Continuous No-Till	All	3 - 9
All other systems including pastures, range, and trees	All	All	0 – 6

¹ **NOTE:** State regulations for application of animal wastes take precedence over these guidelines. Possible differences include nutrient extraction methods, soil sampling depths and frequency, and recommended nutrient application rates and volumes specified in this standard.

² Sampling at additional depths may be needed if stratification or deep accumulation of nutrients are anticipated.

SOIL SAMPLING PROTOCOLS

Texas Cooperative Extension. Soil Sample Information Form. 2000. D-494, p.2.

Provin, T. L., and J. L. Pitt. 2002. Testing Your Soil: How to Collect and Send Samples. TX Cooperative Extension, L-1793. (available at <http://texaserc.tamu.edu>)

Texas Commission on Environmental Quality. 2003. Soil Sampling for Nutrient Utilization Plans. TX Comm. Env. Qual. Reg. Guid., Water Quality Div., RG-408. (available at <http://www.tceq.state.tx.us> (in “Site Search” type “RG-408” and press Go)).

APPENDIX 3

ACCEPTABLE SOIL TEST METHODS

<u>N:</u>	NO ₃ -N by Cd reduction. Methods for chemical analysis of water and wastes. 1979. EPA 200.7, Nat. Environ. Res. Cen., Cincinnati, Ohio.
<u>P, K, Ca, Mg, Na and S:</u>	Mehlich III by inductively coupled plasma (ICP)
<u>Fe, Mn, Zn and C:</u>	Lindsey, W. L., and W. A. Norvell. 1978. Development of a DTPA soil test for zinc, iron, manganese, and copper. Soil Sci. Soc. Amer. J. 42:421-428.
<u>B:</u>	Mahler, R.L., D.V. Naylor, and M.K. Fredrickson. 1983. Hot water extraction of boron from soils using sealed pouches. Unpublished. Univ. Idaho. 12.

APPENDIX 4

TAMU NUTRIENT MANAGEMENT WEB SITE

Each of the following URL addresses will take you to the same web site.

They are: <http://wastenotwantnot.tamu.edu>
<http://nmp.tamu.edu>
<http://nutrientmanagement.tamu.edu>

Soil Testing: <http://soiltesting.tamu.edu>

Check this site frequently for updates on Nutrient Management which include TAMU Crop Recommendations, Planning Tools, Certification Courses and Continuing Education Units, Links, and other reference materials.

APPENDIX 5

USDA – NRCS, TEXAS, WEB SITE

The following URL address will take you to the Texas NRCS eFOTG web site. To get to the Texas Nutrient Management Standard and fact sheets, follow the instructions below:

http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=TX

Click the portion of Texas that you desire.

Click the county desired.

Click Section IV in the left column under eFOTG

Type: 590 in the Search Menu above eFOTG and click: GO

Click on the desired item under Nutrient Management in the left column

NRCS, Texas

August, 2005

APPENDIX 6

Commercial fertilizers will be applied in accordance with Texas A&M recommendations.
Application of all organic soil amendments will not exceed the values in Table 1 or 2.

TABLE 1. A Nutrient Management Plan (NMP) is required where Soil Test P Level ^{1/} is

- less than 200 ppm statewide or,
- less than 350 ppm in arid areas ^{2/} with a named stream greater than one mile.

P – Index Rating	Maximum TMDL Annual P Application Rate ^{5/}	Maximum Annual P Application Rate	Maximum Biennial Application Rate
Very Low, Low	Annual Nitrogen (N) Requirement	Annual Nitrogen (N) Requirement	2.0 Times Annual N Requirement
Medium	2.0 Times Annual Crop P Requirement ^{3/}	2.0 Times Annual Crop P Requirement ^{3/}	2.0 Times Annual N Requirement
High	1.5 Times Annual Crop P Requirement ^{3/}	1.5 Times Annual Crop P Requirement ^{3/}	Double the Maximum Annual P Application Not to Exceed 2 times the Annual N Requirement
Very High	1.0 Times Annual Crop P Requirement ^{3/}	1.0 Times Annual Crop P Requirement ^{3/}	Double the Maximum Annual P Application Not to Exceed 2 times the Annual N Requirement

TABLE 2. A Nutrient Utilization Plan (NUP) is required by TCEQ where Soil Test P Level ^{1/} is:

- equal to or greater than 200 ppm in non-arid areas ^{2/} or,
- equal to or greater than 350 ppm in arid areas ^{2/} with a named stream greater than one mile or,
- equal to or greater than 200 ppm in arid areas ^{2/} with a named stream less than one mile.

P – Index Rating	Maximum TMDL Annual P Application Rate ^{5/}	Maximum Annual P Application Rate	Maximum Biennial Application Rate
Very Low, Low	1.0 Times Annual Crop P Removal ^{4/}	Annual N Crop Removal	2.0 Times Annual N Removal
Medium	1.0 Times Annual Crop P Removal ^{4/}	1.5 Times Annual Crop P Removal ^{4/}	Double the Maximum Annual P Application Not to Exceed 2 times the Annual N Crop Removal
High	1.0 Times Annual Crop P Removal ^{4/}	1.0 Times Annual Crop P Removal ^{4/}	Double the Maximum Annual P Application Not to Exceed 2 times the Annual N Crop Removal
Very High or soil test P ^{1/} => 500 ppm in nutrient impaired TMDL areas. ^{5/}	0.5 Times Annual Crop P Removal ^{4/}	0.5 Times Annual Crop P Removal ^{4/}	Double the Maximum Annual P Application Not to Exceed 2 times the Annual N Crop Removal

Footnotes Applicable to both Tables

^{1/} Soil test P will be Mehlich III by inductively coupled plasma (ICP).

^{2/} Non-arid areas, counties receiving => 25 inches annual rainfall, will use the 200 ppm P level while arid areas, counties receiving < 25 inches of annual rainfall, will use the 350 ppm P level. See map in TX Agronomy Technical Note 15, Phosphorus Assessment Tool for Texas, for county designations.

^{3/} Not to exceed the annual nitrogen requirement rate.

^{4/} Not to exceed the annual nitrogen removal rate.

^{5/} TMDL watersheds are designated by Texas Commission on Environmental Quality (TCEQ).

APPROVAL AND CERTIFICATION

NUTRIENT MANAGEMENT

(acre)

CODE 590

PRACTICE STANDARD APPROVED:

_____	_____ July 5, 2000 _____
State Agronomist	Date

This practice standard is needed in the _____ Field Office Technical Guide.

_____	_____
District Conservationist	Date

CERTIFICATION:

Reviewed and determined adequate without need of revision.

_____	_____
Zone Agronomist	Date